

A MERCURY BUDGET FOR BERRYS CREEK TIDAL MARSH
PROPOSED PLAN AND BUDGET

PREPARED FOR:

THE NEW JERSEY SPORTS AND EXPOSITION AUTHORITY
GATEWAY 1
NEWARK, NEW JERSEY

SDMS Document



82394

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August 5, 1975

Mr. John Krumpe
Executive Director
New Jersey Sports and Exposition Authority
Gateway 1
Newark, New Jersey

Dear Mr. Krumpe:

Enclosed herewith is a proposed plan and estimated budget for an investigation designed to define A Mercury Budget for Berrys Creek Tidal Marsh. Because field sampling will require a full year, the overall time-frame for this investigation is approximately 16 months. I recommend that the first samples be collected during late August 1976 at a time that will coincide with the peak standing crop of marsh grasses.

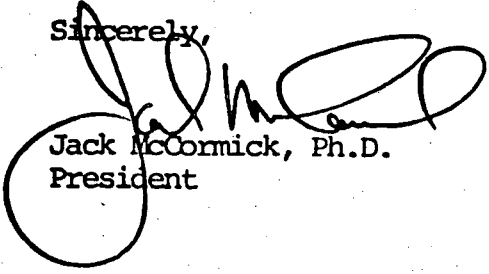
This investigation originated with tests made by JMA during 1972 in studies made to support the environmental assessment of the original plans for the Sports Complex. Those tests first revealed the local mercury problem. Additional tests during February 1974 indicated that the contamination extended deeper than originally believed. During May and June 1974, a pollutant spill upstream introduced more mercury to the system, and suggested that mercury releases may continue for years or decades.

Recommendation 9 of the Hearing Officer's Report requires the Authority to treat the contaminated Berrys Creek Tidal Marsh. The United States Army Engineering District, New York, has claimed jurisdiction, and has notified the Authority that a Federal permit will be required for any work on the marsh. This proposed investigation is designed to obtain the information necessary to formulate an adequate plan for the enhancement of the area, and to explain the basis for the plan to all persons who will be involved in the State and Federal environmental reviews.

Funds adequate to cover the expenses of this investigation were included in the budget published in the bond prospectus. Those funds originally were intended for the marsh-scraping process, but that technique now is known to be inadequate.

This letter is to request your authorization to proceed with the investigation as outlined. Insofar as possible, staff assigned to monitoring operations will conduct field sampling. Every effort to economize will be made without jeopardy to the quality of the scientific work.

Sincerely,


Jack McCormick, Ph.D.
President

/vmt

ENCLOSURE

A MERCURY BUDGET FOR BERRYS CREEK TIDAL MARSH

Proposed Plan and Budget

I. Introduction

Proposed construction will eliminate approximately 35 acres of the total of 165 acres in the Berrys Creek tidal marsh in the Borough of East Rutherford, Bergen County, New Jersey. As partial mitigation for the loss of fish and wildlife habitat, and to assure that the delicate environmental balance of the Hackensack Meadowlands will be protected, the New Jersey Sports and Exposition Authority (NJSEA) is required to enhance the quality of 130 acres of the Berrys Creek tidal marsh. The marsh now is contaminated grossly with mercury that apparently originated from former industrial discharges.

During the spring of 1975, representatives of NJSEA met with personnel from the New York District of the Corps of Engineers, the Boston Region of the United States Fish and Wildlife Service, the New York Region of the United States Environmental Protection Agency, the Gloucester Region of the National Marine Fisheries Service, the Hackensack Meadowlands Development Commission, and the New Jersey Department of Environmental Protection. At this meeting, the NJSEA agreed, as a condition for a permit to construct embankments, that a plan for the enhancement of the Berrys Creek tidal marsh will be submitted to the New York District no later than 18 months after the issuance of a permit. The plan is to be reviewed, and must be approved, by the State agencies with jurisdiction before it is submitted to the Federal agencies.

The purpose of this Proposed Plan and Budget is to implement the necessary field investigations to determine the mercury budget of the marsh and the ultimate fate of the mercury. All contemporary sources of mercury are to be identified; all mercury sinks will be located and described; and all mechanisms by which mercury is transported will be targeted and quantified. Only with such information can an adequate plan for enhancement be formulated and explained to the satisfaction of all persons who will be involved in the environmental review.

II. Existing Mercury Concentrations in Berrys Creek Tidal Marsh

Analyses of sediment samples collected from the Berrys Creek tidal marsh on 5 June 1972, revealed that the concentrations of mercury and other heavy metals were unusually high (Draft Assessment, 1972, page VII-II).¹ Additional samples were collected on 15-16 June 1972, and analyses of those samples substantiated that mercury concentrations ranged 2.3 to 26.0 mg/km (or parts per million) in the upper 0-2 inches of marsh sediment, and from 7.0 to 208.0 mg/km at a depth of 4-6 inches (Table 1). Samples from the bottom of a drainage channel indicated a concentration of 74.0 mg/kg from 1-2 inches, 38.0 mg/km from 3-4 inches, and 0.3 mg/kg from 4-6 inches (Table 1).

Additional samples collected from the Berrys Creek tidal marsh on 21 February 1974 were analyzed to validate or correct the previous results. The 1974 tests confirmed the 1972 finding that the Berrys Creek marsh is heavily contaminated with mercury. Concentrations measured during February ranged from 5.5 to 75.0 mg/km dry weight of soil (Table 1).

Unpolluted sediments contain approximately 0.05 mg/kg.² The marsh deposits contain 46 to 4160 times this much mercury. In studies of sediments from San Francisco Bay, the southern California coast, New Haven Harbor (Connecticut), the Murderkill River and St. Jones River (Delaware), and the Lallave River and estuary (Nova Scotia), concentrations of mercury were found to range from 0.02 to 4.70 mg/kg.³ The concentration of mercury in Berrys Creek tidal marsh, expressed as the mean of the 30 analyses available, is 34.13 mg/kg, or more than seven times as great as the highest concentration reported in these previous studies.

Implications Of The Results

1. The degree of contamination varies from place to place throughout the marsh, but all stations are significantly polluted with mercury.

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- ¹ Jack McCormick & Associates. 1972. Draft assessment of the potential environmental impact of the construction and operation of a New Jersey Sports and Exposition Complex at a site in East Rutherford, Bergen County, New Jersey. Prepared for the New Jersey Sports and Exposition Authority variously paged, 316 pp.
 - ² Klein, D. H. 1972. Some general and analytical aspects of environmental mercury contamination. *Journal of Chemical Education* 49:7-10
 - ³ Lepple, F. K. 1973. Mercury in the environment. A global review including recent studies in the Delaware Bay Region. University of Delaware, College of Marine Studies, 75 pp.

Table 1. Results of analyses for mercury in sediments collected during June 1972 and February 1974 from the Berrys Creek tidal marsh, Bergen County, New Jersey. All concentrations are in milligrams of mercury per kilogram of oven-dry sediment. Stations are located in Figure 1.

	1972			1974		
	0-2	2-4	4-6	MAT	0-6	30-36
1 ^a	19.0	-	7.4			
2 ^{a, c}	74.0	38.0	0.3			
3 ^a	26.0	-	44.0			
4				29.2	61.7	8.3
5 ^b	3.0	-	208.0			
6				28.4	60.1	7.1
7				37.8	40.6	9.1
8 ^b	2.3	-	8.2			
9				29.9	36.7	14.6
10 ^b	6.0	-	7.0			
11 ^b	6.7	-	96.2			
12				33.9	75.0	5.5

^a Results presented in impact statement (1972), page VII-15.

^b Results presented at public hearing (1972).

^c Sample from bottom of drainage channel; other samples are from marsh areas.

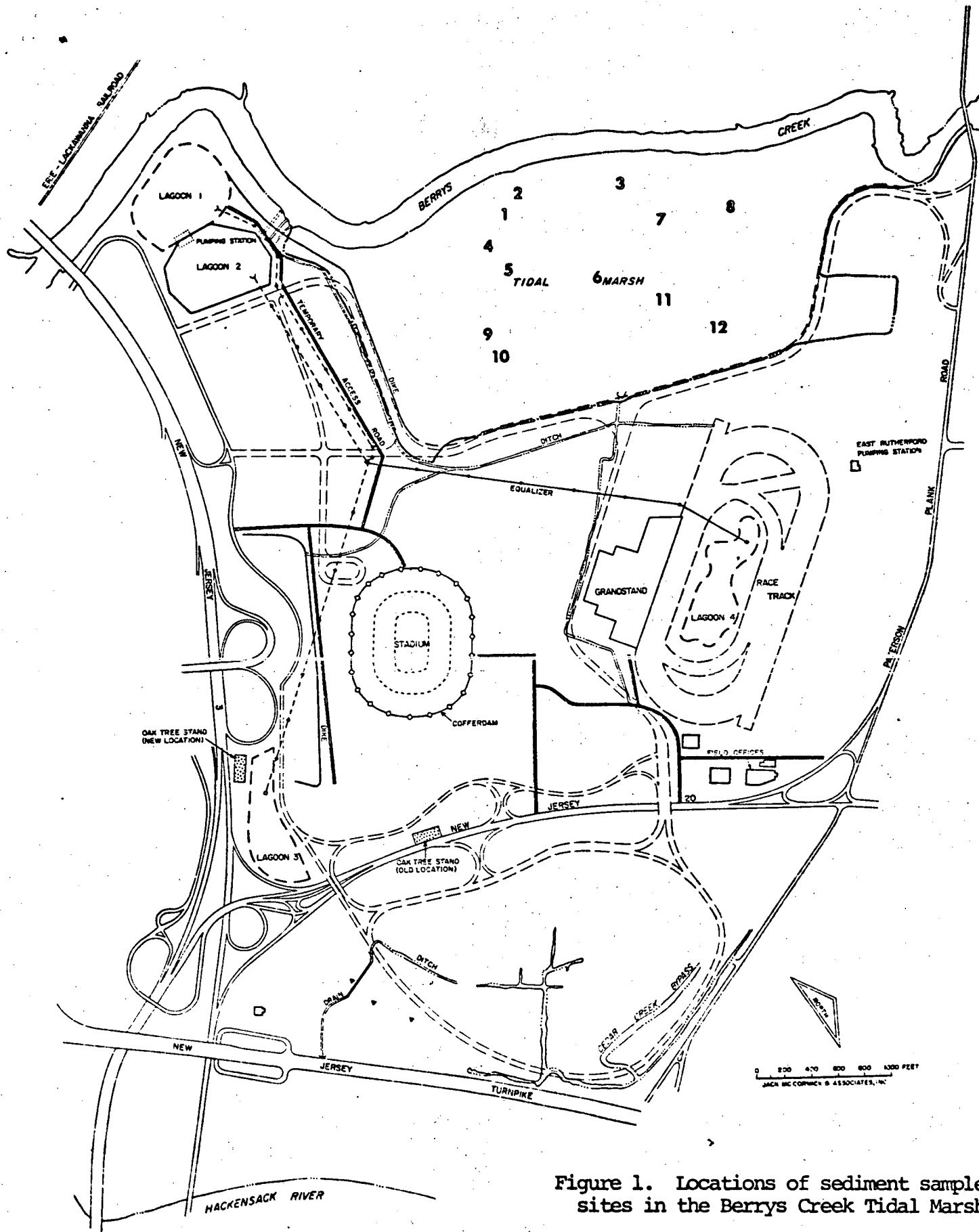


Figure 1. Locations of sediment sample sites in the Berrys Creek Tidal Marsh.

2. The degree of contamination of the tidal marsh varies with depth in the sediment. The heaviest contamination is in the upper 0-6 inches (36.7 to 75.0 mg/kg), but significant contamination extends at least to a depth of 30 to 36 inches (5.5 to 14.6 mg/kg)
3. Within the upper 6 inches of the marsh sediments, contamination was less from 0-2 inches (2.3 to 26.0 mg/kg) than from 4-6 inches (7.0 to 208.0 mg/kg) at five of six stations. This suggests that the source of mercury had been abated so that more recent sediments are not contaminated and tend to mix with and dilute older sediments, or that mercury is mobilized and lost in solution from the upper sediments.
4. Mercury concentrations in the meadow mat, or dead plant remains and live rootstocks, were high (28.4 to 37.8 mg/kg) than concentrations in the upper 2 inches of marsh sediment (2.3 to 26.0 mg/kg). This suggests that the marsh plants absorb mercury and incorporate the metal into their tissues. The presence of significant mercury concentrations at depths from 30-36 inches below the soil surface also could reflect downward translocation of mercury by plant rhizomes and roots.
5. Distribution of mercury in the stream channel sediments was dissimilar to that in the marsh. A high concentration was detected in the upper 0-2 inches, an intermediately high concentration from 2-4 inches, and an "uncontaminated" condition from 4-6 inches. These data suggest that (a) contaminated sediments may be mobile in the channel — that is, they may move in suspension or as a bottom load during storms, and travel from the marsh drainage into Berrys Creek and thence to the Hackensack River; (b) the sediments removed are replaced continuously by sediments eroded from the marsh surface; and (c) there is no downward movement of mercury into the deeper channel bottom sediments because no rooted plants are present. The lack of downward movement also may reflect the fact that the channel bottom is at or slightly below the mean low water line. Under this condition, there probably is no net downward movement of water through the sediment.

The 1972 tests were limited to the upper 6 inches of marsh soil. During most of the public hearing in 1972, only results from Stations 1, 2, and 3 were available, and these generally indicated that the degree of contamination decreased rapidly with depth. Furthermore, information from the regulatory agencies suggested that mercury contamination was known to have been a problem only since about 1940. On the basis of this information, it was assumed that sediments deeper than 6 to 12 inches would be relatively free of pollution. The 1974 test, however, indicated that the sediments are contaminated significantly to a depth of at least 3 feet. In the 165 acre marsh, therefore, a total of 800,000 cubic yards of sediments may be contaminated.

Contamination During 1974

Routine monitoring by JMA measured a concentration of 136 $\mu\text{g/l}$ mercury in water collected on 17 May 1974 at Receiving Point 1 on the Sports Complex. This value is 136 times as great as the maximum concentration recommended by US-EPA. Concentrations of mercury in water samples collected at Station WHN on 20 May and at Station CCP4 on 29 May were 6.8 and 4.6 $\mu\text{g/l}$, respectively. These two stations are located on streams or ditches that drain directly to the Hackensack River.

On 29 May, a burning substance was observed by Bergen County Health Department personnel on the surface of the West Riser Ditch, a tributary that joins Berrys Creek north of Paterson Plank Road. Other agencies were notified, and an investigation determined that the substance originated from the site formerly occupied by the Wood-Ridge Chemical Company (W-RCC). Apparently a water main was ruptured during site-clearing operations. The water flooded waste chemicals stored on the site and carried them into the stream.

Allegedly, a sample of the oily substance was tested in the US-EPA laboratory at Edison, New Jersey, and the concentration of mercury was found to exceed 10,000 mg/l . Agency personnel reported that the soil at the W-RCC had absorbed a considerable volume of the contaminated waste. Leaching of the material during periods of heavy rainfall may constitute a long-term source of mercury.

III. Potential Sources of Mercury

The source of the mercury which now contaminates the Berrys Creek tidal marsh is not known certainly, but is believed to have originated from operations of the former Wood-Ridge Chemical Company (W-RCC). The W-RCC plant was located on the West Riser Ditch of Berrys Creek, about 1.8 miles north of Paterson Plank Road. The facility allegedly was placed under orders during the middle-1960's, and discontinued operations during the late 1960's.

During 1974, significant concentrations of mercury were detected in the waters of Berrys Creek during May. About 29 May, a spill of oily waste was observed on the West Riser Ditch. A sample of this waste that allegedly was analyzed by the US-EPA contained more than 10,000 ppm mercury. Although State and Federal officials have expressed a belief that mercury spilled on the soil at the W-RCC site may pollute Berrys Creek for many decades, no monitoring currently is under way to detect the concentrations of mercury in Berrys Creek.

A major question that must be answered by this investigation is:
Is there a source (or sources) from which mercury now enters the Berrys Creek tidal marsh?

The potential sources are:

1. Berrys Creek, from the site contaminated by the May 1974 spill;
2. Berrys Creek, detritus or dissolved mercury compounds derived from other contaminated wetlands on the stream;
3. Particulate matter in the atmosphere.

Another question to be answered is: "In the Berrys Creek tidal marsh, what are the mercury sinks?"

The most probable sinks are:

1. Mineral sediments;
2. Organic sediments; and
3. The biota (plants and animals).

A particularly important question, insofar as the formulation of a plan for the enhancement of the Berrys Creek tidal marsh is concerned, is:
"Does mercury move from the Berrys Creek tidal marsh and, if it does, how is it transported?"

The mechanisms believed to be operable are:

1. The production of soluble methyl mercury;
2. Sediments eroded from the marsh;
3. Plant detritus flushed from the marsh; and
4. Animals that leave the marsh.

IV. Outline of Work and Estimated Budget

1. Stations to be sampled.

Several stations will be established. Approximately 90% of the determinations of mercury, however, will be made on samples collected from four "primary stations" to be located in the Berrys Creek tidal marsh or adjacent waters. At three "secondary stations," samples will be collected on two dates. A pair of stations will be utilized to determine if mercury still is being released from the W-RCC site north of Paterson Plank Road. The third station will be utilized to obtain samples from a marsh that is believed to be relatively free from mercury contamination. As many as ten "tertiary stations" will be sampled one time to identify the area affected by severe mercury contamination.

Primary stations (4)

- Station 1. In Berrys Creek tidal marsh.
- Station 2. In Berrys Creek tidal marsh.
- Station 3. In Berrys Creek, near Sports Complex discharge.
- Station 4. In Berrys Creek, near Paterson Plank Road.

Secondary stations (3)

- Station 5. Upstream from Wood-Ridge Chemical Company site.
- Station 6. Downstream from Wood-Ridge Chemical Company site.
- Station 7. In the Saw Mill Creek Wildlife Management Area.

Tertiary stations (< 10)

Stations 8 through 17. These will be located in tidal marsh areas located adjacent to Berrys Creek or to the main stem of the Hackensack River.

2. Sediment samples to be tested.

a. Samples to determine depth of contamination.

One test will be made at each of the seven (7) primary and secondary stations to determine the depth to which mercury has entered the soil profile. At each station, one core of soil, to a depth of 8 feet, will be extracted from each of two sites that will be spaced about 5 feet apart. Samples of soil will be taken from each core at points that correspond to nine depths, as follows: 0.5 feet, 1 foot, 2, 3, 4, 5, 6, 7, and 8 feet. The two samples (one from each core) from each of the nine depths will be composited. In total, nine (9) mercury determinations will be made for each of the seven stations.

7 Stations X 9 sediment samples = 63 analyses

b. Samples to quantify sediment transport rate.

Mercury that is present in the sediments of the Berrys Creek tidal marsh either is adsorbed onto clay minerals or exists within particles of organic debris. It is not likely that any significant proportion of the mercury is adsorbed on sands or gravels.

- i) The first procedure to be utilized will be a test to determine the relation between grain size and composition of the sediments and the abundance of mercury.

At three stations in the tidal channels, surface sediments will be collected at depths of 0 to 1 cm, 1 to 2 cm, and 2 to 3 cm beneath the surface. The specified depths will be modified if there are obvious changes in the color, texture, or composition of the sediments.

Each sample will be run through a 230 mesh (63 micron) sieve to separate the silt- and clay-size fraction from sand and larger fractions. The silt- and clay-size fraction then will be analyzed by the Bouyoucos method or pipette tests. Each separate size fraction then will be weighed and analyzed for mercury content.

3 stations X 3 depths X 3 fractions = 27 analyses

- ila) If mercury is concentrated largely in the silt-and clay-sized fraction of the sediment, the movement of mercury will be determined by monitoring nonfilterable solids. (Alternative)

Regular measurements of suspended sediments in Berrys Creek will be made in Task 3.b. of this investigation. These samples will satisfy the needs of Task 2.b.ii.a. for normal tidal cycles.

To provide information on transport during storm events, additional collections will be made during four storm periods. Two sets of samples will be obtained during the summer season, and two will be made in winter when vegetation cover is at a minimum. Collections will be made at three depths in the water column at three stations.

4 dates X 2 tides X 3 depths X 3 stations = 72 analyses

- iib) If the mercury largely is concentrated in the sand-sized on larger fraction of the sediments (not likely), the transport of mercury will be monitored by measuring the rate of movement of the bed load. (Alternative.)

Movements of the bed load in the stream channels will be determined by the use of fluorescent minerals (willemite or calcite). These minerals will be ground to the size of the sand grains in the local sediments.

On twelve occasions, the movements of the fluorescent grains will be traced throughout a full tidal cycle. These tests will be scheduled to coincide with a variety of lunar tide conditions, and are expected to provide a range of wind conditions. In addition, on one or more occasions (three are budgeted), the movement of fluorescent grains will be traced during a major storm event.

These data will be utilized to estimate the total volume of sediment and the amount of mercury transported in the channel bedload annually.

- iii) The third procedure in this phase of the investigation is designed to estimate the total movement of marsh sediments during major storms.

Infrequent major storms probably move more sediment from the marsh during a few hours than does the normal ebb and flood of tidal currents throughout the remainder of the year. It is particularly important in this investigation, therefore, to develop an estimate of sediment export, import, and vertical redistribution during storm events. Measurements will be made during four storm events, two of which will be during the growing season and two will be during the winter season.

Two approaches will be employed. To quantify the net change on the marsh surface, permanent sample points will be established and marked with wooden stakes. The relative elevation of the marsh surface at each station will be measured before and after each storm event. Approximately four shallow cores will be taken at each station before and after each storm event. The mercury content in one core will be determined for intervals from 0 to 1 cm, 1 to 2 cm, and 2 to 3 cm. Sediment sizes will be determined for each interval in all four cores.

3 stations X 3 depths X 1 core X 2 times X 4 storms = 72 analyses

During the storm event, water samples will be drawn at three stations from three elevations within the water column at intervals of 2 hours. The total amount of suspended sediment in each sample will be determined, and the sediment size class distribution will be determined. Subsamples of each size class of sediment from collections made on rising tides and on falling tides will be analyzed for mercury concentration.

3 stations X 2 tides X 3 fractions X 4 storms = 72 analyses

The data developed during this phase of the investigation will be used to estimate the total annual movement of marsh sediments during monthly maximum storms. In conjunction with the information from other phases, a total budget for mercury transport by sediments will be developed.

- iv) The fourth procedure is a component analysis to determine the exact site of mercury in suspended sediments and in sediments after deposition.

Mercury may remain in a particular sediment component while it is in suspension and after deposition. Alternatively, the sediments may adsorb mercury from solution after deposition, and may act only as a temporary sink.

A scanning-electron microscope with capability for elemental analysis will be utilized to conduct the component analysis. One series of three samples will be analyzed. One sample will be of suspended sediment and two will be of bottom sediments.

- c. Samples to identify potential source of mercury.

Grab samples of surficial sediments from the channel bottom at Stations 5 and 6 will be collected on two dates. On each date, samples from several places spaced about 5 feet apart will be composited, and one determination will be made for each station.

2 stations X 1 sediment sample X 2 dates = 4 analyses

- d. Samples to assess contamination of other wetlands

Sediments will be collected in 4 inch cores at Stations 8 through 17, which will be located in tidal marsh areas adjacent to Berrys Creek, upstream and downstream from the Sports Complex site, or on the main stem of the Hackensack River. Four cores will be collected in each area. Materials from 0 to 2 inches and 2 to 4 inches in the cores from each station will be composited and then analyzed for mercury.

10 stations X 2 depths X 1 date = 20 analyses

3. Water samples to be tested.

- a. Samples to determine to concentration of mercury in the water of Berrys Creek at the marsh.

Samples of water will be collected from Berrys Creek at Stations 3 and 4 two times during each month during a full year. One sample will be taken on each date immediately before high water, and a second sample will be taken immediately before the succeeding (or preceding) low water.

These samples will be filtered to remove detritus and other suspended solids. The concentration of dissolved mercury in the filtered water then will be determined.

2 stations X 2 water samples X 12 dates = 48 analyses

- b. Samples to determine the concentration of mercury in detritus and other suspended solids in Berrys Creek.

Plankton nets will be suspended in Berrys Creek at Station 3 and 4 two times during each month during a full year. One sample will be collected by suspending a net at each station during a full rising tide. A second sample will be collected by suspending a net at each station during a full falling tide. (As an alternative, water will be pumped from each station and drained through a net during a full tidal rise and a full tidal fall.) The collected solids will be drained on a centrifuge, and the concentration of mercury will be determined. The concentration will be expressed on an oven-dry weight basis.

2 stations X 2 sediment samples X 12 dates = 48 analyses

- c. Samples to determine the concentration of mercury in the water of Berrys Creek at the suspected source of contamination.

Samples of water will be collected from Berrys Creek at Stations 5 and 6 on one date each three months (4 times during the year). One sample will be taken on each date immediately before high water, and a second sample will be taken immediately before the succeeding (or preceding) low water. These will be coordinated with samples collected for Task 3.a. The water will be filtered, and the concentration of mercury will be determined.

2 stations X 2 water samples X 4 dates = 16 analyses

- d. Samples to determine the concentration of mercury in particulates trapped by rain water.

An automatic rain gage will be used to collect composite samples of rain water during each month for a full year. One composite sample will be analyzed each month.

1 station X 1 water sample X 12 dates = 12 analyses

4. Plant samples to be tested.

a. Samples of common reed grass from Berrys Creek Tidal marsh.

Samples of common reed grass (*Phragmites communis*), which forms the predominant vegetation on the marsh, will be collected at or near Stations 1, 2, 3, and 4 during the prime growing season (August), at the end of the growing season (mid-October), during the winter (January), and in spring (May). Each sample will be divided into five subsamples, as appropriate (roots, rhizome, culms, leaf blades, and flowers/seeds). The oven dry weight of each subsample and the concentration of mercury in each subsample will be determined.

4 stations X 5 plant subsamples X 4 dates = 80 analyses

b. Samples of common reed grass from the uncontaminated tidal marsh.

As a control for determination made in task 4. a. samples of common reed grass will be taken during August from Station 7 in the uncontaminated tidal marsh. The material will be sorted and processed in the same manner as that collected for task 4. a.

1 station X 5 plant subsamples X 1 date = 5 analyses

c. Samples of cattail and cordgrass from Berrys Creek tidal marsh.

Cattail and low-water cordgrass occupy small areas in Berrys Creek tidal marsh. To provide information on the relative absorption of mercury by these plants, two samples of each species will be taken in August, October, January, and May from appropriate stands near Station 3 or 4. This information will be useful for planning possible marsh vegetation management strategies. Material will be sorted and processed in the same manner as that collected for Task 4. a.

2 species X 2 samples X 5 plant subsamples X 4 dates = 80 analyses

d. Samples of cattail and cordgrass from the Sawmill Creek tidal marsh.

Samples of cattail and low-water cordgrass will be collected from one station in the Sawmill Creek Wildlife Management Area. The material will be sorted and processed in the same manner as that collected for the Task 4. a. The results of these tests will provide control data for comparison with the information acquired in task 4. a.

2 species X 5 plant subsamples X 1 date = 10 analyses

e. Plant litter and detritus" samples from Berrys Creek tidal marsh.

Dead plant material will be collected from the marsh surface during November, January, and March at one place near each of the primary stations (Stations 1, 2, 3, and 4). This material will be rinsed to remove sediments, oven dried, and analyzed to determine the concentration of mercury.

4 stations X 1 plant sample X 3 dates = 12 analyses

5. Samples of fish and wildlife

a. Samples of killifish from Berrys Creek tidal marsh.

During May, August, November, and February, two killifish will be collected each day for five consecutive days (10 fish) from channels in Berrys Creek tidal marsh. The mercury content of each fish will be determined.

10 fish X 4 dates = 40 analyses

b. Samples of killifish from uncontaminated marsh.

During August, two killifish will be collected each day for five consecutive days at Station 7 (10 fish). They will be processed as in task 5. a.

10 fish X 1 date = 10 analyses

c. Samples of muskrats from Berrys Creek tidal marsh.

Ten muskrats will be collected from the Berrys Creek tidal marsh. To determine the tissue(s) in which mercury concentrates, samples of the brain, kidney, liver, muscles, fat and whole blood from four muskrats will be analyzed separately for mercury content. The two principal concentrating tissues of six other muskrats will be analyzed.

4 animals X 6 tissues = 24 analyses

6 animals X 2 tissues = 12 analyses

d. Samples of muskrats from other areas in the Hackensack Meadowlands.

Ten muskrats will be collected from each of three other sites in the Meadowlands District (Anderson Creek, Sawmill Creek, and W-ROC Site). The two principal concentrating tissues in each of these specimens will be analyzed. These data will indicate the range of variability in the body loads of muskrats at various distances (0 to 6.6 miles) from the suspected mercury source.

10 animals X 3 sites X 2 tissues = 60 analyses

e. Samples of muskrats from an uncontaminated marsh.

As a control, ten muskrats will be collected from an uncontaminated wetland about 40 miles west of the Meadowlands. The two principal concentrating tissues will be analyzed in each specimen.

10 animals X 2 tissues = 20 analyses

6. Vegetation standing crop analyses.

Once each month throughout the year (12 dates), all live plants and all recently fallen dead plant material will be collected from 25 plots, each 0.25 square meter, spaced randomly in Berrys Creek tidal marsh. These data will provide estimates of the total amount of living and recently dead plant material contained in the marsh. In conjunction with plant tissue sample analyses (Section 4), they will permit an estimation of the total amount of mercury present in the vegetation and the seasonal flux of mercury.

7. Project coordination and completion

	<u>Hours</u>	<u>Loaded Rate</u>	<u>Total Salary</u>
Coordination and interim analysis of data			
1 day/month X 12 months, Roginski	96	\$ 20.01	\$ 1,921
1 day/month X 12 months, Bleiweiss	96	14.56	1,398
0.5 day/month X 12 months, Dawson	72	11.53	830
			<u>\$ 4,149</u>
Final analysis and report preparation			
Bleiweiss literature review	120	14.56	1,747
Bleiweiss analysis and finalization	80	14.56	1,164
Schmid (wildlife and fish)	80	22.10	1,768
Brown (Limnology)	16	25.22	404
Hirsch (sediments)	40	21.25	850
Roginski (heavy metals, water)	80	20.01	1,601
McCormick	40	40.50	1,620
Typing (Dyer) ¹	120	11.48	1,378
Meetings with NJ-DEP, HMDC, US-EPA			<u>\$10,532</u>
US-fish and wildlife, US-NOAA, Corps, SCS			
(2 State Agencies, 5 Federal Agencies)			
Estimated "small meetings" with HMDC, NJ-DEP, Feds			
Total of 15 meetings, 1.0 day each (including travel)			
McCormick	80	40.50	3,240
Roginski	96	20.01	1,921
Bleiweiss	120	14.56	1,747
			<u>6,908</u>
Group meetings (all agencies together)			
Total of 2 meetings, 1.5 day each (with travel)			
McCormick	24	40.50	972
Roginski	24	20.01	481
Bleiweiss	24	14.56	350
			<u>1,803</u>
Report production ¹			<u>7,500</u>
			<u>\$ 30,892</u>

¹ The report will contain 40 pages of typed tables to display all mercury data and standing crop measurements. It will have 5 other tables for synthesis, 30 photographs (17 stations, 13 others), 15 figures (maps, graphs, diagrams) and 100 pages of text. Estimated printing cost (per copy) is \$75. say 100 copies \$7,500.

8. Summary of mercury analyses to be made on various media.

<u>Task</u>	<u>Sediments</u>	<u>Water</u>	<u>Plants</u>	<u>Animals</u>
2. a.	63			
2. bi.	27			
2. biia.	72 ^a			
2. biib.	0 ^a			
2. biii.	72			
2. biv.	0			
2. c.	4			
3. a.		48		
3. b.	48			
3. c.		16		
3. d.		12		
4. a.			80	
4. b.			5	
4. c.			80	
4. d.			10	
4. e.			12	
5. a.				40
5. b.				10
5. c.				36
5. d.				60
5. e.				20
6.			0	
Totals	214 (286)	76	187	166

^a Alternatives; either 2. b. ii. a. or 2. b. ii. b. will be implemented.

V. Schedule of Estimated Costs for Mercury Budget Investigation

Work tasks are numbered to correspond with sections of the text. All salaries are based on 1975 scales. A contingency line is included at the bottom of the schedule to account for salary increases and inflationary increases in direct costs during 1976 as well as minor errors in estimation of time requirements.

Task	Mercury Analyses	Galluzzi Hours	Other Hours	Loaded Salary ^a	Other Costs	Total
2a	\$ 1,575 ^e	24		294	\$ 2,725	\$ 4,594
2b	2,475 ^e	520	412 ^b	15,085	2,550	20,110
2c	100 ^e	8		98		198
2d	500 ^e	40	16 ^c	636		1,136
3a	864 ^f		32 ^c	292		1,156
3b	1,200 ^e	96		1,176		2,376
3c	288 ^f	16	8 ^c	269		557
3d	216 ^f	19.2		235	750	1,201
4a	4,000 ^g	80		980		4,980
4b	250 ^g	16		196		446
4c	4,000 ^g	64		784		4,784
4d	500 ^g	16		196		696
4e	600 ^g	24		294		894
5a	2,400 ^h	40		490		2,890
5b	600 ^h	16		196		796
5c	2,160 ^h	16		196		2,356
5d	3,600 ^h	16		196		3,796
5e	1,200	16		196		1,396
6	0	192		2,400	840	3,240
7	0	0	1,208 ^d	23,392	7,500	30,892
Subtotals	26,528			47,601	14,365	79,494
Mileage, vehicles, tolls, per diem on travel (based on 63 trips, two men, overnight)						7,000
Contingency for 1976 costs (20%) ^j						86,494
						17,300
						\$ 103,794
Round to:						\$ 104,000

^a Contract multiplier for 1975 is 2.25

^b Hirsch

^c King

^d Various persons, see detail in text.

^e Sediment samples are \$25 per analysis

^f Water samples are \$18 per analysis

^g Plant samples are \$50 per analysis

^h Animal samples are \$60 per analysis

ⁱ Estimated cost is based on alternative 2biib.

^j Billings will reflect actual costs and contract multiplier during 1976.